APPENDIX A. CONCURRENT POLICY ACTIVITIES RELEVANT TO ZNE GOALS

Concurrent Policy Activities Relevant to ZNE Goals

Activity	Goal 1 Awareness	Goal 2 Education	Goal 3 Tech tools	Goal 4 Financing	Goal 5 Infra-structure	Goal 6 Alignment	Description
California State Legislature 2013-14 session							
AB 327[1] **Residential electricity rate reform and solar net metering policy**				X	X		Status: Enrolled and presented to the Governor (9/25/13) The bill revises the current Net Energy Metering (NEM) statute to specify the maximum program capacity for customers in IOU service areas and also requires the PUC to develop a new NEM program by July 2015 and establish a transition to the new NEM program by 2017. The new NEM program is to be based on electrical system costs and benefits to nonparticipating ratepayers and remove both the total system capacity cap and the one megawatt project size limit. Existing NEM customers will be transitions no later than December 2020 to the new NEM. Authorize the PUC to approved fixed monthly charges no greater than $10 for residential customers and $5 for low-income customers beginning in 2016.
SB 43[2] **Green Tariff Shared Renewables Program**				X	X		Status: Chaptered 9/28/13 The Green Tariff Shared Renewables Program seeks to build on the success of the California Solar Initiative by expanding access to all eligible renewable energy resources to all ratepayers who are currently unable to access the benefits of onsite generation. The Green Tariff Shared Renewables Program would require a participating utility, defined as being an electrical corporation with 100,000 or more customers in California, to file with the commission an application requesting approval of a green tariff shared renewables program which enables ratepayers to participate directly in offsite electrical generation facilities that use eligible renewable energy resources, consistent with certain legislative findings and statements of intent. The bill intends such a program to run from July 1, 2014 through January 1, 2019.
SB 84[3] **EPIC, NSHP funding and PACE financing**				X			Status: Unfinished business July 2013 The bill will require the California Energy Commission to develop and administer the EPIC program with a focus on ratepayers and with annual reporting to the Legislature. It does not change the authorization status of the program and continued funding for NSHP from Renewable Resource Trust Fund. For Property Assessed Clean Energy (PACE) loans, this bill introduces a risk mitigation program to increase its acceptance in the marketplace.
AB 39[4] **Energy: conservation: financial assistance**				X			Status: Ordered to inactive file at the request of Senator Padilla (9/12/13) The Energy Conservation Assistance Act of 1979 requires, until January 1, 2018, the State Energy Resources Conservation and Development Commission to administer the State Energy Conservation Assistance Account, a continuously appropriated account to provide grants and loans to local governments and public institutions to maximize energy use savings. AB39 would extend the operation of the act to January 1, 2020, and would thereby make an appropriation by extending the time during which the funds in a continuously appropriated account are made available.

[1] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB327
[2] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB43
[3] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB84
[4] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB39

Activity	Goal 1 Awareness	Goal 2 Education	Goal 3 Tech tools	Goal 4 Financing	Goal 5 Infra-structure	Goal 6 Alignment	Description
AB 1014[5] Energy: electrical corporations: green tariff shared				X	X		Status: Referred to Committee on Rules after first read in Senate (6/13/13) Assembly Bill 1014 aims to enable residential and commercial consumers to purchase solar energy from an off-site system or project of up to 20MW. It is estimated that as many as 75% of California utility customers cannot install their own on-site generation due to shading from trees or other buildings or because they rent their home or business premises.
AB 341[6] Green Building Standards						X	Status: Enrolled and presented to Governor (9/9/13) Requires the Building Standards Commission to integrate the existing Green Building Code (CalGreen) into the appropriate sections of the California Building Code (Title 24 of the California Code of Regulations). Existing law provides that if no state agency has the authority or expertise to propose green building standards applicable to a particular occupancy, the commission shall adopt, approve, codify, update, and publish green building standards for those occupancies. This bill would require the commission and state agencies that propose green building standards to allow for input by other state agencies that have expertise in green building subject areas. The bill would require the process by which these other state agencies shall submit suggested changes for consideration to be adopted as administrative regulations that include certain elements.
California Air Resources Board							
AB 32 (2005-06) California Global Warming Solutions Act of 2006.					X	X	Prepare and approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from sources or categories of sources of greenhouse gases by 2020. Identify the statewide level of greenhouse gas emissions in 1990 to serve as the emissions limit to be achieved by 2020
California Energy Commission							
IEPR – Integrated Energy Policy Report	X				X	X	The California Energy Commission adopts an Integrated Energy Policy every two years and an update every other year. The report makes energy policy recommendations based on the Energy Commission's energy assessments and forecasts with the intent of conserving resources, protecting the environment, providing reliable energy, enhancing the state's economy, and protecting public health and safety. The 2011 IEPR supported the ZNE goals and the 2013 IEPR proceeding is actively addressing ZNE definition/s.
Title 24 (part 6) Building Energy Efficiency Standards Codes and Standards			X			X	California's Building Energy Efficiency Standards are updated on an approximately three-year cycle. These Standards address newly constructed buildings and additions and alterations to existing buildings. • 2013 Standards go into effect Jan 1, 2014 • Development cycle for 2016 Standards to kick off in Oct 2013 with Standards adopted by Q1 2015
EPIC (CEC) Electric research program					X		Electric rate payer funded research program administered through the Energy Commission and IOUs. The portion of the EPIC Program administered by the Energy Commission will provide funding for applied research and development, technology demonstration and deployment, and market facilitation for clean energy technologies and approaches for the benefit of ratepayers of the 3 IOUs. Energy Commission submitted a Triennial plan[7] to CPUC on Nov 1, 2012 for the 2013 – 2016 timeframe.

[5] http://legiscan.com/CA/bill/AB1014/2013
[6] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB341
[7] http://www.energy.ca.gov/2012publications/CEC-500-2012-082/CEC-500-2012-082-SD.pdf

Activity	Goal 1 Awareness	Goal 2 Education	Goal 3 Tech tools	Goal 4 Financing	Goal 5 Infra-structure	Goal 6 Alignment	Description
AB 758[8] (2009-10) – Comprehensive Energy Efficiency Plan for Existing Buildings	X		X				AB 758 requires the Energy Commission, in collaboration with the California Public Utilities Commission and stakeholders, to develop a comprehensive program to achieve greater energy efficiency in the state's existing buildings. The Energy Commission is implementing AB 758 in three phases. Phase I of which was the development of Scoping Report which will result in the adoption of an AB 758 Action Plan (expected by end of 2013). The Phase II will follow and implement the Action Plan. Phase II is expected to open a proceeding related to the HERS rating as relevant to California and would impact not just the existing homes but the potential rating of new homes as well.
NHSP – New Solar Homes Partnership - solar incentives for residential new construction only				X			The California Energy Commission's New Solar Homes Partnership (NSHP) is part of the comprehensive statewide solar program, known as the California Solar Initiative. The NSHP provides financial incentives and other support to home builders, encouraging the construction of new, energy efficient solar homes that save homeowners money on their electric bills and protect the environment.
Appliance Efficiency Program (Title 20)			X				The Energy Commission's Appliance Efficiency Program develops standards as well as maintains Appliance Efficiency Database for the State. It also works towards compliance, enforcement and outreach activities. Current activity includes Order Instituting Rulemaking (OIR) for efficiency standards for additional set of appliances.
AB 1109 (2007-08) Lighting Efficiency			X				AB 1109 tasks the California Energy Commission with reducing lighting energy usage in indoor residences and state facilities by no less than 50%, by 2018, and require a 25% reduction in commercial facilities by that same date. To achieve these efficiency levels, the California Energy Commission would apply its existing appliance efficiency standards to include lighting products, as well as require minimum lumen/watt standards for different categories of lighting products.
California Public Utilities Commission							
Strategic Plan update California Long term Energy Efficiency Strategic Plan – policy document	X	X	X	X	X	X	In October 2007, the California Public Utilities Commission (CPUC) created a framework to make energy efficiency a way of life in California by refocusing ratepayer-funded energy efficiency programs on achieving long-term savings through structural changes in the way Californians use energy. An update was issued in January 2010 which added a Lighting chapter. Several Action Plan efforts and documents have been developed in response during the time period, including this Action Plan. The CPUC's Energy Division has proposed updating and potentially restructuring the Strategic Plan in the 2013-14 timeframe.
CSI (California Solar Initiative) – solar incentives				X	X		The California Solar Initiative (CSI) is the solar rebate program for California consumers that are customers of the investor-owned utilities - Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E) and for all market sectors other than residential new construction.
CSI RD&D[9]			X		X		The goal of the California Solar Initiative (CSI) Research, Development, and Deployment (RD&D) plan is to help build a sustainable and self-supporting industry for customer-sited solar in California. To achieve this, the legislature authorized the CPUC to allocate $50 million of the California Solar Initiative budget. Nearly $38 million has been funded to date on projects spanning from grid integration to technology, business model and integration of EE with DR, solar and storage. Demonstration projects addressing renewables and grid interconnection challenges are the focus of the program's final solicitation.

[8] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100AB758
[9] http://calsolarresearch.ca.gov/

Activity	Goal 1 Awareness	Goal 2 Education	Goal 3 Tech tools	Goal 4 Financing	Goal 5 Infra-structure	Goal 6 Alignment	Description
Self-Generation Incentive Program – incentives for distributed generation other than solar				X	X		The CPUC's Self-Generation Incentive Program (SGIP) provides incentives to support existing, new, and emerging distributed energy resources. The SGIP provides rebates for qualifying distributed energy systems installed on the customer's side of the utility meter. Qualifying technologies include wind turbines, waste heat to power technologies, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, fuel cells, and advanced energy storage systems.
Rule 21- interconnection					X		Electric Rule 21 is a tariff that describes the interconnection, operating and metering requirements for generation facilities to be connected to a utility's distribution system, over which the California Public Utilities Commission (CPUC) has jurisdiction.
NEM – Net Energy Metering				X	X		Customers who install small solar, wind, biogas, and fuel cell generation facilities (1 MW or less) to serve all or a portion of onsite electricity needs are eligible for the state's net metering program. NEM allows a customer-generator to receive a financial credit for power generated by their onsite system and fed back to the utility. The credit is used to offset the customer's electricity bill. NEM is an important element of the policy framework supporting direct customer investment in grid-tied distributed renewable energy generation, including customer-sited solar PV systems.
Meter Aggregation also known as VNM – Virtual Net Energy Metering				X	X		Virtual Net Metering (VNM) is a special tariff available to multifamily housing owner to allocate a solar system's benefits to tenants across multiple units. VNM allows landowners to choose the best location for solar or wind on their property and then use the power generated to offset their bills from any of their electricity meters on the same or contiguous properties. Contiguous properties must be owned, leased, or rented by the same owner as the property where the energy facility is located. A Resolution issued by the CPUC on Sept 19, 2013 (E-4610[10]), finds that allowing eligible NEM customer generators to aggregate their load from multiple meters, pursuant to SB 594, will not result in an increase in the expected revenue obligations of customers who are not eligible customer-generators. The CPUC authorizes the IOUs to modify their NEM tariffs to implement the meter aggregation provision of SB 594 legislation.
Investor Owned Utilities							
California Advanced Homes Program (CAHP) – Residential New Construction (RNC) Program	X			X			The 2013 California Advanced Homes Program serves to encourage residential new construction to meet two visionary goals set forth by the California Public Utilities Commission. The first is for 90% of residential new construction to be built to at least 20% better than the 2008 code by 2015. The second is for all new homes to reach Zero Net Energy by 2020.
ETP – Emerging Technologies Program			X				The IOUs' Emerging Technologies Program (ETP) conducts numerous initiatives to bridge the gap between R&D and market adoption of new and/or unproven technologies, as well as emerging and/or under-utilized technologies; reports about these ETP initiatives are published on the Emerging Technologies Coordinating Council (ETCC) website.

[10] http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M077/K158/77158265.PDF

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WE&T[11] – Statewide Workforce Education and Training Program	X	X					IOU energy training programs are run through eight Energy Centers throughout the State. Activities revolve around targeted courses, technical consultations, outreach events and building performance tool loans through lending libraries. In the current 2013-14 cycle, utility education, training and workforce programs will continue to focus on implementing the recommendations from a 2010 Workforce, Education and Training Needs Assessment study [12] and ensuring efforts are aligned with California's Energy Efficiency Strategic Plan.
C&S (Codes and Standards) Program			X				The California Investor Owned Utilities (IOUs) are actively supporting the California Energy Commission (CEC) in developing the state's building energy efficiency standard (Title 24). Their joint intent is to achieve significant energy savings through the development of reasonable, responsible, and cost-effective code change proposals for the 2013 code update. Through Codes and Standards Enhancement (CASE) Studies, the C&S Program provides standards and code-setting bodies with the technical and cost-effectiveness information required to make informed judgments on proposed regulations for promising energy efficiency design practices and technologies.
EPIC (IOU)					X		The IOU administered portion of EPIC is focuses on Technology Demonstration and Deployment projects under Renewable Distributed energy resources; Grid Modernization and Optimization; Customer Service and Enablement (Smart Customers - DSM); and Cross-cutting foundational strategies and technologies. The IOUs submitted EPIC research plans to the CPUC on Nov 1, 2012 for 2013 – 2016 time frame.
Other							
DOE – Building America[13]		X	X				DOE's Building America Program started almost 15 years ago has enabled innovation in residential building energy performance through funding teams to develop high performance homes. Building America research teams and DOE national laboratories offer the building industry specialized expertise and new insights from the latest research projects.
Local Jurisdiction Adopted Reach Codes				X			Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards (Standards) establishes a process which allows local adoption of energy standards that are more stringent than the statewide Standards. This process allows local governments to adopt and enforce energy standards before the statewide Standards effective date, require additional energy conservation measures, and/or set more stringent energy budgets. Local governments are required to apply to the Energy Commission for approval, documenting the supporting analysis for how the local government has determined that their proposed Standards will save more energy than the current statewide Standards and the basis of the local government's determination that the local standards are cost-effective.
Property Assessed Clean Energy (PACE) financing				X			Property Assessed Clean Energy (PACE) financing, an alternative to a loan, is designed to encourage the installation of renewable-energy systems and improve energy efficiency by helping property owners overcome the barrier of high up-front energy equipment and installation costs. While PACE financing does not reduce the total price tag of a solar-energy system, it helps make a system more affordable by spreading the cost of the system over a long time period.

[11] http://www.cpuc.ca.gov/NR/rdonlyres/14B16390-D021-453B-9390-1F59C3693B4B/0/201314WETFactSheet.pdf
[12] http://www.irle.berkeley.edu/vial/publications/ca_workforce_needs_assessment.html
[13] http://www1.eere.energy.gov/buildings/residential/ba_index.html

Activity	Goal 1 Awareness	Goal 2 Education	Goal 3 Tech tools	Goal 4 Financing	Goal 5 Infra-structure	Goal 6 Alignment	Description
Federal Investment Tax Credit (ITC)[14]				X			The ITC is a 30 percent tax credit for solar systems on residential (under Section 25D) and commercial (under Section 48) properties. The multiple-year extension of the residential and commercial solar ITC has helped annual solar installation grow by over 1,600 percent since the ITC was implemented in 2006 - a compound annual growth rate of 76 percent. The existence of the ITC through 2016 provides market certainty for companies to develop long-term investments that drive competition and technological innovation, which in turn, lowers costs for consumers.
Solar Leasing and Power Purchase Agreements (PPA)				X			Third-party financing of solar PV has become the predominant business model in some of the largest residential markets in the U.S. today, third-party financed residential installations comprise greater than 50% of new capacity in California, Arizona, Colorado and Massachusetts, with the model gaining greater market share in other states such as Connecticut, Delaware, Maryland, New Jersey, New York, Oregon, Texas, Vermont, and Washington.[15] The solar lease model allows home owners to have rooftop solar with as low as zero dollars down costs and monthly lease payments that break even or lower their overall electricity expenses on an annual basis through net metering arrangements.
CAL Green (Title 24 Part 11)[16]						X	Part 11 of the 2010 Title 24 Building Standards Code is the California Green Building Standards Code, also to be known as the CALGreen Code. It is a voluntary code which is adopted by state agencies and other jurisdiction. The Title 24 part 6 update cycle also impacts the CALGreen code. The Building Standards Commission[17] is responsible for its update.

[14] http://www.seia.org/policy/finance-tax/solar-investment-tax-credit
[15] http://www.greentechmedia.com/research/report/u.s.-residential-solar-pv-financing
[16] http://www.documents.dgs.ca.gov/bsc/documents/2013/2013-Green-Residential-Mandatory.pdf
[17] http://www.bsc.ca.gov/

APPENDIX B. TECHNOLOGY PROGRESS TO DATE

TECHNOLOGY PROGRESS TO DATE

Introduction

Of the multiple aspects that need to overlap for a successful ZNE design, the technical aspect is the most basic and the first in order. Without the technical feasibility of an approach or measure, further investigation into financial or regulatory challenges or market adoption issues is not prudent. Therefore the ability to achieve ZNE hinges first of all on the technology developments available. The good news, for the most part, is that there is adequate technology available to enable reaching ZNE, especially for the residential sector. Residential energy use is very envelope-driven as opposed to complex system or process- driven as in the case of nonresidential applications, where the interplay of systems is more challenging. The basic energy needs of a residential building can be classified as thermal comfort and visual comfort, along with the plug loads brought in by the occupants.

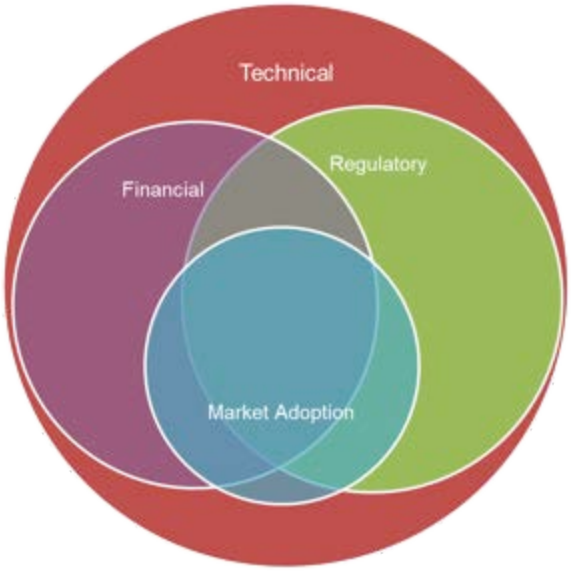

Figure 1: ZNE Solution Space

Therefore, technological aspects of ZNE design can be captured under five major areas:

1. Passive Measures
2. Active Measures
3. Control Measures
4. Distributed Energy Generation
5. Distributed Energy Storage

Figure 2: Technical Measures for ZNE

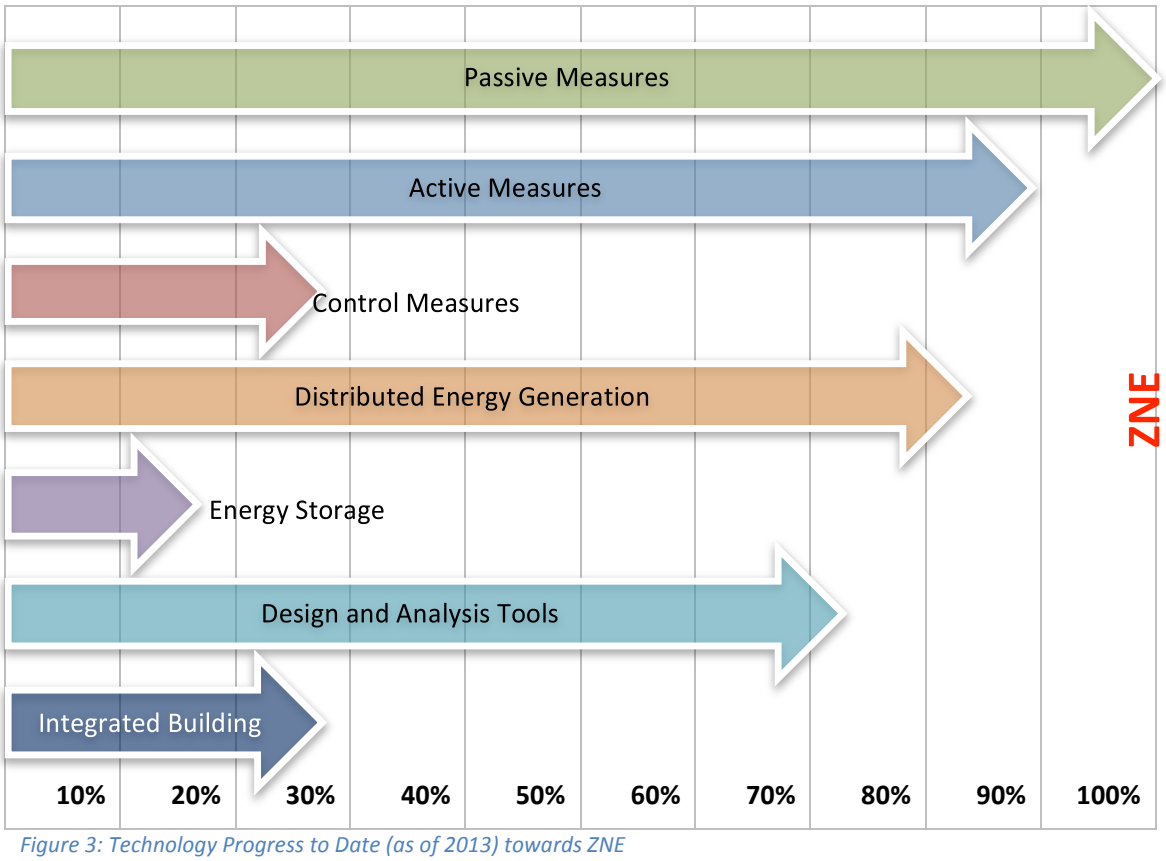

Figure 3: Technology Progress to Date (as of 2013) towards ZNE

Passive Measures

Passive measures are those that do not need the input of energy to make them work, they provide efficiency through their inherent energy interactions be they thermodynamic or lighting. For example, offices and hotels by design have large core spaces which need conditioning and lighting no matter the time of day or year. Residential building design lends itself more to loads that can be driven and therefore controlled through appropriate design measures. Natural space, heating, cooling, ventilation and lighting have all been employed in vernacular architecture as a response to climate. All historic civilizations have been found to have evidence of aligning streets and orientating buildings to utilize the solar gains based on the climate of the location. This is often referred to as "bioclimatic architecture"[18] and the design principles of this approach are well documented. The use of these principles in contemporary design has declined, but the technology as such, in terms of the science, is available. The challenge, then, relates more to the market or design professions and facilitating a paradigm shift to these methods. Some examples of building elements that are considered passive are: sun spaces, trombe walls, solar chimneys and high thermal mass adobe walls. In terms of technology updates, building envelope materials have become more thermally insulating.

Building Envelope Material

- Wall material innovations have been related to increasing insulation levels in the wall cavity and their quality installation. SIPs[19] walls and the availability of sprayed foam insulation have furthered wall R-24 values for 4 x 6 inch construction, and removed the quality control challenges of loose fill or sagging batt insulation.
- Cool roofs are highly reflective, highly emissive roofing materials that stay 50 to 60 degrees F cooler than a normal roof under a hot summer sun. Clay and concrete roof tile for sloped residential applications are now available and can average 20% savings on cooling costs. The reflectivity and emittance factor of cool roof tiles are at least 0.4 and 0.8 respectively.
- Fenestration design and technology has also seen vast improvement of the recent past with window assemblies that have extremely low u-factors 0.2 and glass with high visible transmission to allow light but prevent heat transmission. The Efficient Windows Collaborative[20] promotes higher efficiency in windows and making NFRC[21] certification and labeling more universal.

[18] http://bioclimaticx.com/bioclimatic-architecture1/
[19] Structural Insulated Panels (SIP)
[20] http://www.efficientwindows.org/images/ewc.pdf
[21] National Fenestration Rating Council

Active Measures

Active measures need energy to drive them and are typically mechanical in nature. HVAC systems and lighting constitute the primary form of active measures. Technology progress in HVAC and lighting has been fairly significant over the last decade and continues to progress with industry and research at the forefront.

HVAC

While the Federal minimum standard is SEER 14, the HVAC industry is well beyond that number and residential HVAC units with ***SEER 22*** ratings are available now, though at a cost premium. Proper installation of high efficiency technology is critical now to pick up the remaining energy savings opportunities. Proper equipment installation and refrigerant charge along with optimal duct design and layout are equally important. The placement of ***ducts in conditioned spaces*** can account for up to 40% savings in cooling costs. The most promising approach from a constructability standpoint appears to be moving the entire HVAC system out of the attic.[22] Some innovative conditioning technologies that, if found cost effective can achieve higher savings are ground source heat pumps, radiant heating and cooling when climate appropriate, and the use of whole house fans.

Lighting

The shift away from incandescent bulbs has been significant in the last decade and moved towards CFLs that have high efficacy in the 60+ lumens per watt range. However, LED lighting technology is increasingly improving and becoming cost effective while catching up with CFLs in terms of efficacy. Luminaire and fixtures for LEDs are the new cutting edge for high efficiency lighting moving forward.

Domestic Water Heating

Tankless water heating models are relatively new entrants to the market but are gaining market acceptance and currently represent roughly 5% of total sales, the vast majority of which are EnergyStar® qualified gas tankless models at 0.82 energy factor— well over the traditional 0.65 over gas storage tank variety. All other advanced water heater types— including heat pump water heaters (HPWHs), an alternative to electric resistance models; solar water heaters, which use thermal energy from the sun to heat water; and drain water heat recovery, which captures heat from water as it flows down the drain— capture a small fraction of the market.[23]

HPWHs are an emerging technology that uses a refrigerant-based vapor compression cycle to absorb energy from the surrounding air and transfer it to water in an attached storage tank. This type of system currently has an energy factor (EF) rating of 2.0–2.5.

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[22] The Technical Feasibility of Zero Net Energy Buildings in California – Arup study for CA IOUs

[23] ENERGY STAR Water Heater Market Profile, 2010 http://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/Water_Heater_Market_Profile_2010.pdf

Control Measures

Thermostats

Residential thermostats control 9% of the total energy use in the United States and similar amounts in most developed countries; however, the details of how people use thermostats have been largely ignored. Several studies, and considerable anecdotal evidence, suggested that users have encountered difficulty in correctly operating modern, programmable, thermostats.[24] The latest innovation in thermostats has thus been the emergence of "self-learning" and Wi-Fi controlled thermostats that allow for more intuitive user interfaces. Examples of these technologies include the NEST thermostat and iComfort by Lennox.

Lighting controls

Lighting fixtures with dimmable ballasts for CFL are a relatively new technology that needs to be extended to LEDs as well to capture increasing savings. Use of occupancy sensors and photo sensors to operate lighting systems are also increasing becoming cost effective and therefore gaining use in the mainstream.

Home Energy Management (HEM) systems

Given the mantra of "what gets measured (or displayed) gets improved," home energy display systems are a new and increasingly available technology that can result in behavioral changes to produce home energy savings. High price points, effective display and user interfaces are the current technological challenges for energy display systems. HEMs are increasingly being bundled with thermostats and even security system offerings with display and control over Wi-Fi and on mobile devices, and this will be an important market driver going forward. The HEM market has been stuck in near neutral, though, with numerous trials and only a few cases of industry-led deployments or significant consumer uptake. This dynamic is starting to change a bit. Over the coming years, a continued desire among consumers to reduce bills, regulatory mandates for greater efficiency, wider use of variable pricing schemes, and a strong "green" sentiment will combine to help drive adoption forward.[25] Examples of some home energy systems and services include but are not limited to:

- GE Nucleus system[26]
- Wiser Home Energy Management System[27]
- Honeywell display
- Vivint service

[24] http://eec.ucdavis.edu/publications/Usability_of_residential_thermostats.pdf
[25] http://www.pikeresearch.com/research/home-energy-management
[26] http://www.geappliances.com/home-energy-manager/
[27] http://products.schneider-electric.us/products-services/products/energy-management-systems/residential-energy-management-system/wiser-home-energy-management-system1/wiser-home-energy-management-system/

Plug Loads

With the increasing stringency in building standards driving down the energy use of fixed building systems, plug loads are becoming an increasing proportion of home building energy end-uses. In 2009 California Residential Appliance Saturation Survey (RASS) data, plug loads represent over 30% of all residential energy end-uses. Reducing plug loads is a central challenge in achieving ZNE. Technical developments over time, along with appliance standards, have driven down the power consumption of most plug load technologies, such as TVs, computers and battery chargers, and set top boxes; the duration of use or non-use of this equipment, controlled by the end user, is the missing link. Technology options to address usage of even highly efficient plug load appliances are a next potential step, in conjunction with education and outreach activities. Plug load control devices that are also integrated into to HEMs are becoming available to attract and educate the end users as well. The California Energy Commission currently supports the California Plug Load Research Center (CalPlug) at UC Irvine that conduct research on the most promising, innovative, early-stage research and development projects in the plug load area by developing projects that target efficiency improvements in existing and future plug load devices and working with industry, utilities, and standard setting groups to accelerate implementation of plug load improvements into the marketplace.

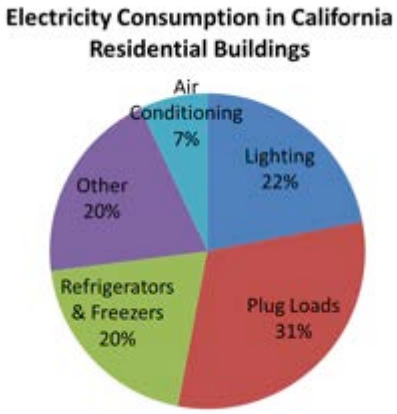


Figure 4: Residential Electricity End-use – **Source: Residential Appliance Saturation Survey 2009**[28]

[28] http://www.energy.ca.gov/appliances/rass/

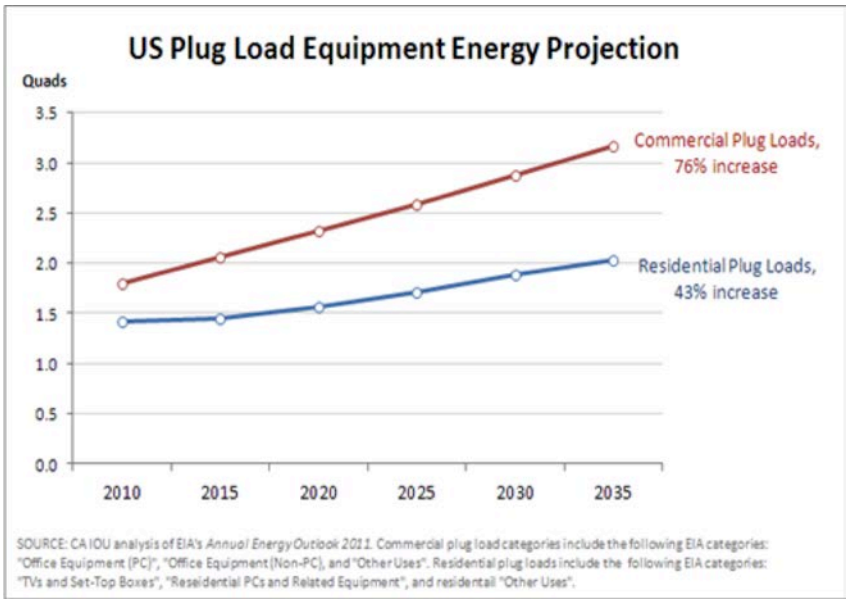


Figure 5: US Plug Load Equipment Energy Projection[29]

Distributed Energy Generation

Building Integrated Photovoltaics (BIPV)

(BIPV) technology is not very different from regular photovoltaic technologies. Cell and module efficiencies for both have been increasing on both crystalline and thin film technologies and a rough rule of thumb estimate for roof area requirements is 100 square feet of un-obstructed roof area for every kilowatt (kW) of PV. But significant challenges have affected product development and market adoption of BIPV over the past 30 years, and several barriers remain. Despite high interest from solar energy stakeholders, substantial research and development efforts, and policy support in some markets, BIPV and semi-integrated PV products accounted for less than 1% (250–300 MW) of global installed capacity of distributed systems in 2009. A primary reason for BIPV's limited deployment is that the average market price of installed systems is currently higher than for rack-mounted PV.[30]

[29] http://www.cbe.berkeley.edu/research/plug-loads.htm
[30] NREL report on residential BIPV Prices http://www.nrel.gov/docs/fy12osti/53103.pdf

Least integrated (Open rack-mounted PV) | **More integrated** (Close roof rack-mounted PV) | **Fully integrated** (Direct-mounted BIPV, multifunctional)

Figure 1. Continuum of residential solar system designs showing increasing integration (from left to right) with building architecture and material

Source: Building Energy 2011, DOE 2011

Solar Water Heating (SHW)

SWH is a mature technology, but the fact remains that SWHs are not cost effective given the current price of natural gas, as was previously identified as the target market for SWH technologies. Continued research and development may lead to significant advances in materials, design, and manufacturability, which can contribute to lowering the cost of SWHs, improving their performance, and easing installation—both in new construction and in retrofit markets.[31]

Christopher Drake, NREL/PIX 09188

Figure 2. Flat-plate collector

Alan Ford, NREL/PIX 09501

Figure 3. Evacuated tube collector

Cost and reliability remain the challenges to overcome in the SWH market at this time. The introduction of a SWH OG-300 System Certification by SRCC is new development in the recent past that spotlights testing on not just the collector panels but the entire system, which gives the market more credibility.

[31] http://www.nrel.gov/docs/fy12osti/54793.pdf Low-Cost Solar Water Heating Research and Development Roadmap

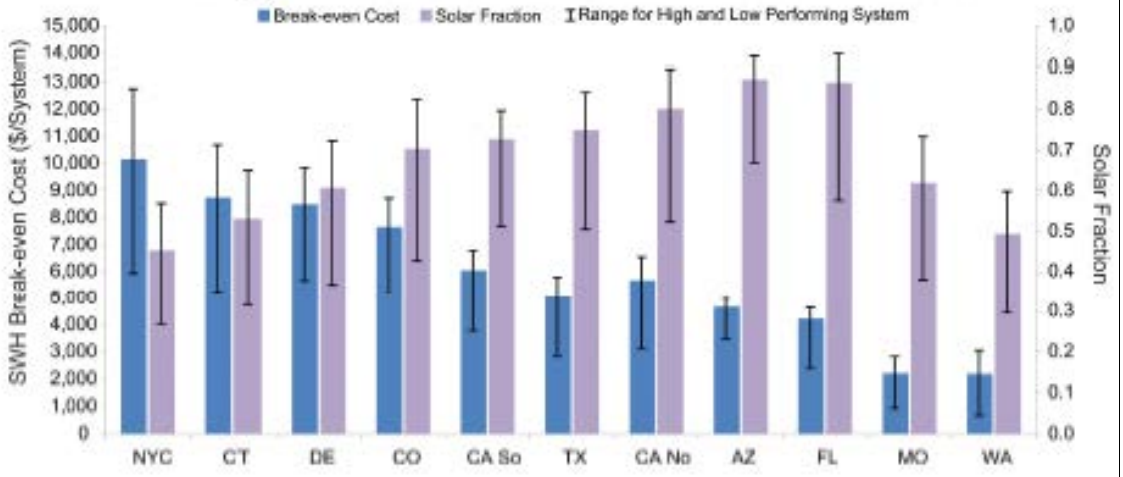


Figure 11. Range in SWH break-even cost and solar fraction for select states for a SWH with an electric auxiliary water heater

[32]

Hybrid Systems

Photovoltaic thermal hybrid solar collectors, sometimes known as hybrid PV/T systems or PVT, are systems that convert solar radiation into thermal and electrical energy.[33] These systems combine a photovoltaic cell, which converts electromagnetic radiation (photons) into electricity, with a solar thermal collector, which captures the remaining energy and removes waste heat from the PV module. Photovoltaic (PV) cells suffer from a drop in efficiency with rises in temperature due to increased resistance. Such systems can be engineered to carry heat away from the PV cells thereby cooling the cells and thus improving their efficiency by lowering resistance. Although this is an effective method, it causes the thermal component to under-perform compared to a solar thermal collector. Recent research showed that photovoltaic materials with low temperature coefficients such as amorphous silicon (a-Si:H) PV allow the PVT to be operated at high temperatures, creating a more symbiotic PVT system. Example of a commercially available residential PVT system is the Echo Solar Systems that provides electricity and hot water and another variation that provides heating and cooling as well.[34]

[32] http://www.nrel.gov/docs/fy11osti/48986.pdf Break-even Cost for Residential Solar Water Heating in the United States: Key Drivers and Sensitivities
http://archive.iea-shc.org/publications/downloads/Solar_Heat_Worldwide-2011.pdf
[33] http://en.wikipedia.org/wiki/Photovoltaic_thermal_hybrid_solar_collector
[34] http://www.echofirst.com/news-netzero.php

Small/Micro Wind

At the residential micro wind turbine level, it is debatable if the turbines are producing the claimed production levels and if the return on investment on these turbines is truly viable.

Combined Heat and Power (CHP)

Once available only to large commercial buildings CHP systems are now being produced on a scale that is safe, practical, and affordable to homeowners. CHP technologies – sometimes referred to as cogeneration – have provided heat and electrical energy efficiently at commercial and industrial sites for many years. Micro-CHP units range in capacity from about 1 kW to 6 kW and are about the size of a major appliance. Installation may be performed initially by specialists and, after the technology matures, by an experienced plumber, electrician, or HVAC technician. Units come as grid-tied systems which connect to utility power as backup or as stand-alone systems for remote residences. One unit with a new, small capacity engine simultaneously produces 1.2 kilowatts of electric power and 11,000 Btus of heat in the form of hot water. The system is combined with a high efficiency, natural gas-fueled warm air furnace or boiler for supplemental space heating. The small engines tend to burn very cleanly - exceeding all emissions requirements for CO2 and NOx. One unit claims to produce less CO and nitrous oxides than a single burner on a kitchen gas range. The primary challenge for getting the highest efficiency and best economic return on CHP is to fully utilize all of the thermal energy produced when generating electricity. As the technology develops, various operating regimes will be tested to optimize the energy available based on variables such as the loads in the home, the climate and the season.[35]

Distributed Energy Storage

Electric Energy Storage

Battery storage in residential applications is gaining popularity when combined with solar to enable use of electricity when rates are higher. While lead acid batteries are more prevalent, Lithium ion batteries are increasingly moving towards becoming safer and a lower price point.

Thermal Energy Storage

Residential thermal energy storage (TES) systems have been discussed since the 1970s and 80s. Recent commercialization of smaller units (3-10 ton) that can serve residential and small commercial markets have now become available. The main benefit of TES systems is peak load reduction by using the thermal energy stored as ice at off peak hours for cooling during the peak pricing hours. The technology works by shifting air conditioning energy use from peak to off-peak periods and storing the energy as ice. During peak daytime cooling, the unit functions as a condenser to provide cooling using refrigerant pump to circulate ice-condensed refrigerant to the evaporator coil.

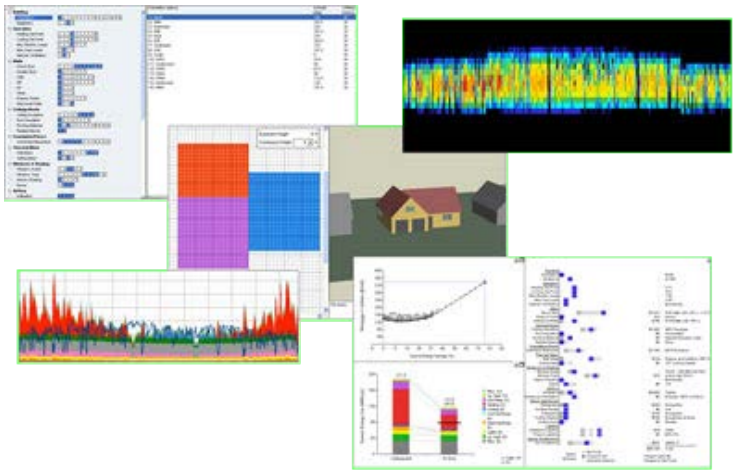
[35] http://www.toolbase.org/Technology-Inventory/Electrical-Electronics/combined-heat-power

Electric Vehicles

With the increasing proliferation of electric vehicles, the charging load of these will need to be addressed as home load. Alternately EVs can serve as electric storage devices and allow peak reduction. The market is still nascent and developing in this arena but needs to be watched keenly to understand the nexus of EVs and residential ZNE buildings.

Technical Analysis Tools

Computational tools that assist in energy analysis at the design stage are key tools to develop ZNE buildings. The exponential increase in and access to desktop or laptop computational power in the last decade has leap frogged energy simulation and modeling tools to very high precision and resolution realms. The hourly time step analysis of the DOE2 era with steady state energy models can now easily be extended to sub hourly levels over the entire year and made to interact with multi-domain models which help in integrated building design process.



BEopt - Integrated analysis platform

The BEopt™ (Building Energy Optimization) software provides capabilities to evaluate residential building designs and identify cost-optimal efficiency packages at various levels of whole-house energy savings along the path to zero net energy. BEopt can be used to analyze both new construction and existing home retrofits, through evaluation of single building designs, parametric sweeps, and cost-based optimizations. BEopt provides detailed simulation-based analysis based on specific house characteristics, such as size, architecture, occupancy, vintage, location, and utility rates. Discrete envelope and equipment options, reflecting realistic construction materials and practices, are evaluated.[36]

BEopt uses existing, established simulation engines (currently DOE2.2 or EnergyPlus). Simulation assumptions are based on the Building America House Simulation Protocols. The sequential search optimization technique used by BEopt:

- Finds minimum-cost building designs at different target energy-savings levels
- Identifies multiple near-optimal designs along the path, allowing for equivalent solutions based on builder or contractor preference

[36] http://beopt.nrel.gov/

BEopt has been developed by the National Renewable Energy Laboratory in support of the U. S. Department of Energy Building America program goal to develop market-ready energy solutions for new and existing homes.

Funded by the Energy Commission's PIER program and the CSI RD&D Program, the tool has been customized to work in the California context. This has entailed the enabling of California specific code rules and weather data, along with utility tariff data and measure cost data for a detailed financial optimization over energy and measure costs.

California Simulation Engine (CSE) [37]

Developing policy requirements for and designing high performance buildings will require better collaboration between government and industry, to leverage limited resources. All market actors involved in the design of and mandate for high performance buildings can benefit from the ability to produce multiple simulations, apply design assumptions and policy requirements to building models, and compare results to design targets. The aggregate of these model-based processes is called "rule-based analysis," a term meant to encompass both building energy simulation and structured modifications to the building models simulated. Modeling tools that implement rule-based analysis for design and product performance investigations can be used by a diverse set of market participants. Architects, designers, product manufacturers, energy consultants, code developers, and program implementers motivated to improve the energy performance of buildings all need access to, and the ability to modify, tools that facilitate rule-based analysis. California is headed down this path with the Energy Commission's development of the California Simulation Engine for Title 24.

Integrated Building Design

"*The Integrated Design Process (IDP) is a method for realizing high performance buildings that contribute to sustainable communities. It is a collaborative process that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle. The IDP is designed to allow the client and other stakeholders to develop and realize clearly defined and challenging functional, environmental and economic goals and objectives. The IDP requires a multidisciplinary design team that includes or acquires the skills required to address all design issues flowing from the objectives. The IDP proceeds from whole building system strategies, working through increasing levels of specificity, to realize more optimally integrated solutions."*[38]

Though more widely used in the context of commercial design, integrated building design is relevant to residential building design processes as well, especially in the quest towards achieving zero net energy. The integrated design process not only brings together multidisciplinary trades and professionals but in

[37] http://www.aceee.org/files/proceedings/2012/data/papers/0193-000379.pdf

[38] Larsson, Nils. 2002. The Integrated Design Process; Report on a National Workshop held in Toronto in October 2001. Toronto: Buildings Group, CETC, Natural Resources Canada, Canada. http://www.greenspacencr.org/events/IDProadmap.pdf

doing so enables the optimization of systems with mutual energy benefits across different systems otherwise treated separately.

Research Development and Demonstration (RD&D) Activities

Public Interest Energy Research (PIER) Buildings Research Activities

Research to date related to ZNE.ZENH 2003 projects and their findings, RESCO, recent solicitation on Community Solar and ZNE technology.

- National Energy Center for Sustainability http://www.necsc.us/docs/CEC_CVRP_Publications.pdf
- http://www.energy.ca.gov/2011publications/CEC-500-2011-019/CEC-500-2011-019-AT4.pdf
- AEC - http://www.energy.ca.gov/2010publications/CEC-500-2010-047/CEC-500-2010-047.PDF
- Global Green - http://www.energy.ca.gov/2011publications/CEC-500-2011-TB/CEC-500-2011-TB-001.pdf
- SunPower - Commercializing_Zero_Energy_New_Home_Communities

Appliances Research Activities

Since 2003, the California Energy Commission has spent nearly $4.5 million on consumer electronics and office equipment research. The following are some examples:

- Developed Test Procedure for External Single Volt Power Supply Test Procedure that resulted in a Title 20 Standard in 2005.
- Conducted TV energy use research that resulted in a Title 20 Standard in 2010
- Developed Battery Charger Test Procedure that resulted in a Title 20 Standard in 2012
- 80 Plus Program39 - an initiative to promote energy efficiency in computer power (now over 3,300 qualified power supplies)
- Revised Energy Star specification for computers that included power factor correction
- Energy Commission funded building a low and ultra-low energy computers – these computers stimulated manufacturers to build computers that use less energy
- Influenced Energy Efficiency Ethernet IEEE 802.3AZ 40and a Protocol to communicate with an external proxy

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[39] Center for the Built Environment (CBE), Study on Simulated and Actual Energy Use: The Role of Plug Loads: Understanding and tightening the gap; http://www.plugloadsolutions.com /80PlusPowerSupplies.aspx

[40] Energy-Efficient Ethernet is a set of enhancements to the twisted-pair and backplane Ethernet family of computer networking standards that will allow for less power consumption during periods of low data activity. The intention was to reduce power consumption by 50% or more, while retaining full compatibility with existing equipment. The Institute of Electrical and Electronics Engineers (IEEE), through the IEEE 802.3az task force developed the standard. The IEEE ratified the final standard in September 2010.

Investor Owned Utility Emerging Technology Program (ETP)

The emerging technology program of the IOUs has led to some recent technology progress contributing to the residential buildings ZNE goal.

Completed projects

- ET Home Energy Management Lab Tech Assessment Smart Thermostats - The assessment aims to evaluate the energy savings potential from a Wi-Fi enabled Honeywell programmable thermostat combined with OPower behavioral software, which can be accessed via the internet or a Smartphone. This assessment will give us an understanding of the energy savings potential to reduce energy consumption through behavior based programs combined with an enabled technology.
- Home Energy Management Insight Behavioral Research Smart Homes - This project was designed to evaluate consumer preferences and attitudes towards home energy management and "Smart Homes" through qualitative focus groups.
- ZNE New Home RFQ - New construction of model homes (RFP)
- Future Outlook for Residential Energy Management - Conduct a market study, an adjunct to a main study, within SCE service territory to understand significant developments and trends in the Connected Home market by investigating consumer and manufacturers attitudes towards residential energy management in a connected home. A connected home can consist of distinct platforms or components that run independently within a home "ecosystem." With the advancements in technology, consumers will purchase and connect more and more devices in their homes to suit their practical needs. In the end, all devices or connections will constitute a building block infrastructure of a connected home.
- ZNE Technical Potential Technical and market potential review to identify ZNE potential of various building types.

Active projects (as of March 2013)

- ZNE Tract Home Retrofit - Residential Retrofit of a number of existing homes of year 2000+ vintage to achieve ZNE or near-ZNE use.
- Advanced Window Films- The Emerging Technologies assessment aims to evaluate the validity of manufacturers' claims and quantify the potential benefits of advanced film products for PG&E customers.
- ZNE Home Retrofit - Demonstration Showcase of Emerging Technologies
- ET Home Energy Management Field Tech Assessment Smart Thermostats - Evaluate the energy savings potential from a Wi-Fi enabled Honeywell programmable thermostat combined with OPower behavioral software, which can be accessed via the internet or a Smartphone. The assessment will give an understanding of the energy savings potential to reduce energy consumption through behavior based programs combined with an enabled technology.
- Chula Vista Energy Showcase Home - Demonstration showcase to demonstrate "deep" energy savings of over 50% and a new "plug & play" solar photovoltaic system in a residential home and to provide a local green job training opportunity.
- HVAC Electrostatic Filter - The majority of residential and commercial air conditioning units include throwaway fiberglass media filters. The electrostatic air filter replaces these filters. In principle, it captures a larger amount of airborne contaminants, captures smaller size contaminants, and operates at a lower air pressure drop than fiberglass media filters.
- Advanced Radiant HVAC Solutions - Comprehensive program that integrates radiant cooling, heating, and related envelope systems and installation methods in California homes.

- Climate Appropriate HVAC - Test, and assist in market adoption and integration of high efficiency air conditioning units optimized for use in arid climates of the South Western United States. (Climate Zones 10 and 14). Promote air conditioners specifically selected to perform well at hot dry conditions.
- Ground Coupled Space Conditioning Technical Potential - Determine the market size in SCE territory based upon known soil properties to better inform the ET Program of the potential for technologies using the ground as a heat exchanger.
- Residential Human Comfort Behavior Study for Low Energy Cooling - Develop a human behavior study to determine and understand SCE's market potential for adopting low energy cooling technologies; specifically evaporative cooling. Currently, evaporative cooling is not utilized widely, although it has the potential to save significant energy over more commonly utilized vapor compression-based technologies.
- Single Family Radiant Cooling System - Single-family residential radiant cooling system with PEX pipes passing off-peak chilled water through radiant dry wall panels. The water is chilled with a standard A/C unit, with the evaporator coil being placed within the chilled water storage tank insulated with structural insulated panels. Radiant heating system will also be installed using hot water from gas water heater.
- Dynalloy - Technology assessment to evaluate energy savings on smart vent register for residential
- ZNE New Home Site 1 - Southern California Edison's (SCE) Emerging Technologies Program (ETP) is seeking to collaborate with Homebuilders to implement Integrated Demand Side Management (IDSM) solutions in Zero Net Energy (ZNE) or near-ZNE model homes. This Demonstration Showcase initiative will focus on creating market awareness and increasing penetration of energy-efficient, cost-effective home building practices key to achieving ZNE or near-ZNE performance.
- Advanced Drywall Insulation - This project will assess the benefits of installing phase change material drywall in a multi-family building. The PCM drywall provides added thermal mass, which is allowing the elimination of conventional cooling systems (all natural ventilation).
- Residential Water Heating Program Proposal - Engineering assistance with modeling tools/design guides, testing standards, and building energy codes.
- Green Plumbing Practice - Developing a workbook on best practices for residential in supporting hot water plumbing
- SF/MF WH data/survey - Comprehensive market behavior study on hot water heating systems at and hot water usage habits of residential customers. The subset of the activity is technology assessment on high efficient water heater on existing participants.

ZNE Case Studies with Technology Focus

- SCE – ABC Green home
- One Sky Homes
- UCD West Village

Databases

- EIA - U.S. Residential Housing Site Energy Consumption http://www.eia.gov/emeu/efficiency/recs_1a_table.htm Residential end uses by year
- Building Energy Data Book – DOE http://buildingsdatabook.eren.doe.gov/ChapterIntro2.aspx Residential end uses by year and fuel type
- DOE Buildings Database https://buildingdata.energy.gov/ Mostly Commercial but has a few residential buildings. Need to search them out as "lodging". Some energy data available, not always

metered, but simulation energy data. Includes multifamily and single family. Hard to search based on EUI or even residential single family or multifamily.

- USGBC Homes- https://new.usgbc.org/projects/homes Information (stories) on LEED homes. Not much of energy use data or information
- DOE – Zero Energy Buildings Database http://zeb.buildinggreen.com/index.cfm Closest to a real ZNE database. Searchable on building type and energy data. Not enough CA buildings represented.
- High Performance Buildings Database http://eere.buildinggreen.com/
- National Residential Efficiency Measures Database - The purpose of this project is to provide a national unified database of residential building retrofit measures and associated costs. These data are accessible to software programs that evaluate most cost-effective retrofit measures to improve the energy efficiency of residential buildings. http://www.nrel.gov/ap/retrofits/group_listing.cfm

CODES AND STANDARDS UPDATES

Building Energy Efficiency Standards (Title 24, Part 6)

The Warren-Alquist Act,[41] enacted in 1976, mandated the Energy Commission to create and periodically update Building Energy Efficiency Standards (Standards) for the state of California. These Standards address newly constructed buildings and additions and alterations to existing buildings. The Standards have, in combination with appliance efficiency standards and utility-sponsored incentive programs, strongly contributed to California's per capita electricity consumption levels remaining relatively flat since the mid-1970s. First adopted in 1977, the Standards have been periodically updated approximately on a three-year cycle. The current 2008 Building Energy Efficiency Standards went into effect on January 1, 2010 and have since been updated as 2013 standards that go into effect January 1, 2014.

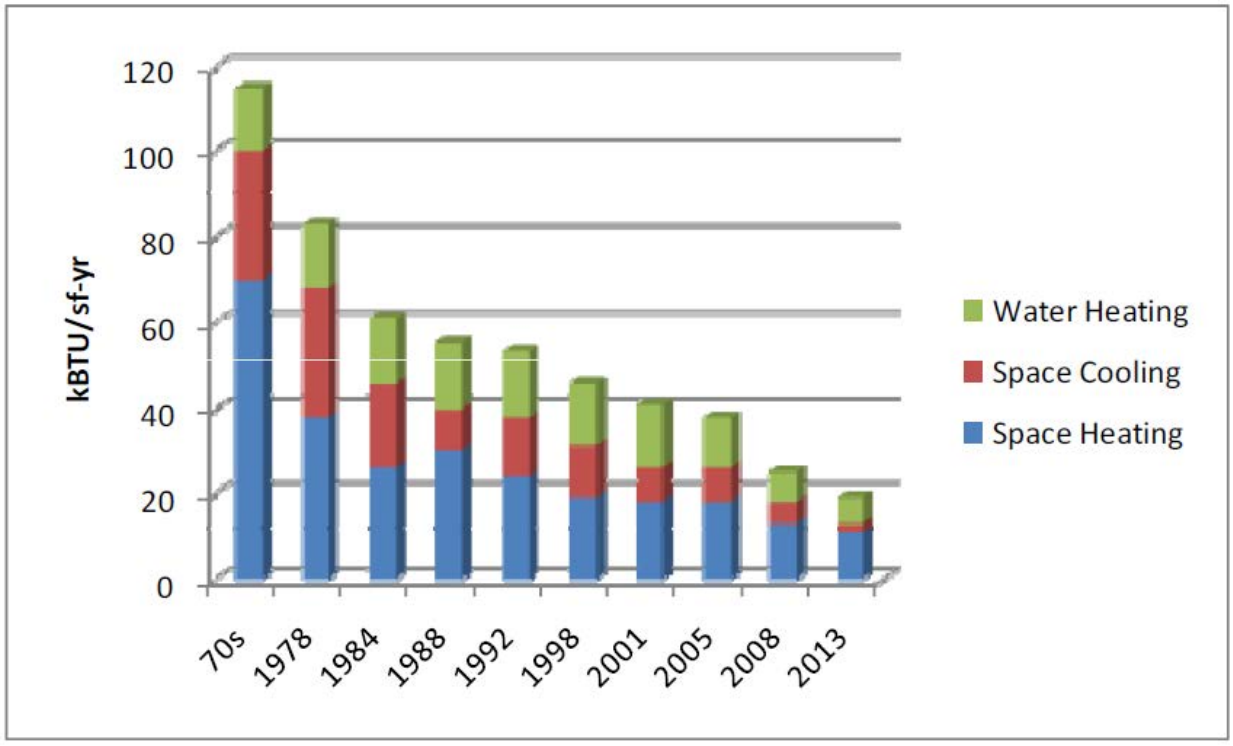


Figure 6: California Building Energy Standards – historic Energy Use Intensity (EUI) per square foot with each update cycle[42]

[41] http://www.energy.ca.gov/2012publications/CEC-140-2012-001/CEC-140-2012-001.pdf

[42] http://www.energy.ca.gov/title24/2013standards/rulemaking/documents/2012-05-31_2013_standards_adoption_hearing_presentation.pdf

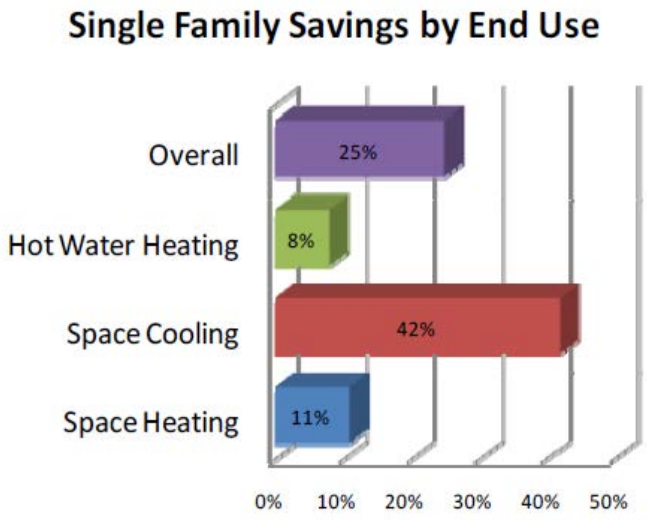


Figure 7: Single Family Residential Savings by End-Use in the 2013 standards update

2013 Residential Building Energy Efficiency Standards Measures Summary[43]

Prescriptive Measures:

1. High Performance Windows – Reducing the U-Factor down to 0.32 and SHGC down to 0.25.
2. Duct Insulation – Raise minimum from R-4.2 to R-6.0 in climate zones 6, 7, and 8.
3. Night Ventilation – Whole house fan as a minimum; allows Smart Vents and Night Breeze as alternatives in CZs 8-14.
4. Adding the Radiant Barrier requirements in CZs 3, and 5-7.
5. Increase wall insulation to R15/4 in all CZs

Mandatory Requirements:

1. Duct sealing in all CZs.
2. Return duct design or fan power and airflow testing (Residential HVAC Quality Installation Improvements).
3. Lighting – Improving and clarifying the mandatory lighting requirements for all residential buildings including kitchens, bathrooms, dining rooms, utility rooms, garages, hall ways, bedrooms, and outdoor lighting.
4. Hot water pipe insulation - Limits the length of one inch pipe to 15 feet, requires insulation on pipes ¾ inch and larger.
5. Solar Ready Measure – 250 square feet of solar ready zone on single family roofs.

[43] California Energy Commission.

Compliance Options

1. Solar Photovoltaic can be used as a compliance option to comply under the performance path.
2. Occupant Controlled Smart Thermostat as a tradeoff against the solar ready zone.
3. All high efficacy lighting in single family and multifamily as a tradeoff against the solar ready zone.

Additions and Alteration

1. Simplified Compliance documentation requirements for small additions and alteration projects that do not involve a HERS measure.
2. Simplified rules for both the prescriptive and performance paths for additions, alterations, and existing plus additions plus alterations.

IOU CASE Studies Adopted in Title 24 2013 Building Energy Standards

- Res-Envelope-Cool Roof
- Res-Envelope-Roof Insulation
- Res-Envelope-Window U-factor and SHGC
- Res-Envelope-Wall Insulation
- Res-Envelope-Infiltration (air sealing)
- Res-HVAC-Zoned AC Systems (dropped cooling credit but kept heating credit)
- Res-HVAC-Mandatory Duct Airflow and Testing (Duct Pressure Drop)
- Res-HVAC-Mandatory Duct Sealing
- Res-HVAC-Refrigerant Charge
- Res-HVAC-Night Ventilation Systems
- Res-HVAC-Whole House Fans
- Res-HVAC-Upgradeable Setback Thermostats
- Res-DHW-MF DHW Controls and Solar Water Heating
- Res-DHW-Single Family DHW (partially adopted)
- Res-DHW-High Efficiency Water Heater Ready
- Res-DHW-Multi-heads Shower
- Res-Lighting (Limited adoption)
- Res-Solar-Solar Ready Homes
- Res-Solar-Solar fraction for Electric Water Heating
- Res-Plug load control

Appliance Standards (Title 20)

Title 20 applies to most electronic systems sold in California that contain battery-charging circuits. The scope includes such items as notebook computers, tablets, power tools, electric toothbrushes, shavers, phones, mobile workstations, and Uninterruptible Power Supplies (UPS). Though the U.S. DOE and the federal ENERGY STAR™ program have related activities, California's Title 20 Appliance Standards regulation is the first of its kind for these devices and is not currently pre-empted by any national or international program requirements.

Appliance	Efficiency standards adopted In Calif.	In U.S.
Air conditioners	1977	1990*
Central air conditioners	1977	1993
Heat pumps	1977	1990
Refrigerators & freezers	1977	1990
Boilers	1978	1992
Furnaces	1978	1990
Plumbing (showerheads)	1978	1994
Hot water heaters	1978	1990
Clothes dryers	1979	1988
Pool equipment	1982	1990
Ballasts for lighting	1983	1990
Lighting	2003	2006
Distribution Transformers	2003	2007
Audio/video equipment	2006	n/a
Commercial cooking appliances	2006	n/a
Televisions	2009	n/a
Battery Charger Systems	2012	n/a

*Updated in 2012

Table 1: California Energy Commission Title 20 Priorities

Topic	Phase 1: (Q2 2012 – Q3 2014)	Phase 2: (Q2 2013 –Q4 2015)	Phase 3: (Q2 2014 – Q4 2016)
Consumer Electronics	**Displays;** **Video game consoles;** **Computers;** **Set-top boxes**	Servers; Imaging equipment	**Low power modes;** **Power factor**
Lighting	**Dimming ballasts;** **Multi-faceted reflector (MR) lamps;** **Light-emitting diode (LED) lamps**	**Lamps exempted by the federal Energy Independence and Security Act ;** **Lighting accessories;** **Outdoor lighting**	Linear fluorescent fixtures

APPENDIX C. SURVEY FINDINGS

APPENDIX C. SURVEY FINDINGS

Introduction

The California Public Utilities Commission (CPUC) began a process in late 2012 to develop of a Residential Zero-Net Energy 2020 Vision Framework to address and help guide the state to meet the goals for California's Long-Term Energy Efficiency Strategic Plan. As part of the process, the CPUC released an online survey to key stakeholders in the state. The goal of the survey was to determine several key items: 1. Interest in ongoing participation in the planning for Residential ZNE; 2. Stakeholder's perceptions about the status, barriers, and needs for Residential ZNE; and 3. The appropriate role for the CPUC in this effort.

Methodology

The survey was developed by CPUC Energy Division staff in charge of residential and commercial ZNE with the assistance of their consultants, BluePoint Planning and Itron. The survey included 37 questions, with a variety of multiple choice, priority/ranking questions, and free form sections. 15 of those questions were designed for more detailed input and responses and were not required nor completed by most respondents. In most instances, unless otherwise noted, responses are evaluated by the number of responses in the "Most Important/Important" or "Very Strong/Strong" categories.

The survey was sent out to existing ZNE stakeholder lists, interested parties and to ZNE statewide group via LinkedIn resulting in 97 responses. Responses from architects; utilities; local government and non-profits represent 51.5%, with each group about equally represented. Nearly 70% of respondents indicated that ZNE is part of their business with 37.1% indicating they have been directly involved with designing or constructing a ZNE home or building. In general, respondents represent managers, directors or principals.

Key Findings

There are several key survey findings that will help to inform the Vision Framework and the CPUC's efforts, including the following:

- Only 5.3% of respondents believe the state is on track to meet its 2020 goal to have 100% of new homes be ZNE. 45.3% said the state is not on track with the remainder unclear about where the state is.
- ZNE Codes and Regulations are indicated as the most critical need and a major priority.
- Focusing on industry (builders, designers and developers) in all areas is important.
- Supporting and encouraging utility incentives is essential.
- Cost sensitivity/affordability and consumer awareness are two weaknesses and challenges that need to be addressed.

Figure 1. Critical needs to achieve the 2020 Goal as indicated by 90% or more of respondents (question 10)

Summary of all findings

The following is a summary of the key results of the survey. The detailed results of the survey and the written responses are provided as an addendum.

How does the ZNE Residential 2020 goal impact your work? (q.6)

In this freeform question, individuals indicated that ZNE goals impact their work in a variety of ways. As illustrated in the adjacent figure the most often mentioned impacts of these goals are: ZNE regulations and policies and its ability to inspire new work/projects. In addition, it was also mentioned that the Residential ZNE work would inform and provide a test case for Commercial ZNE and build overall knowledge.

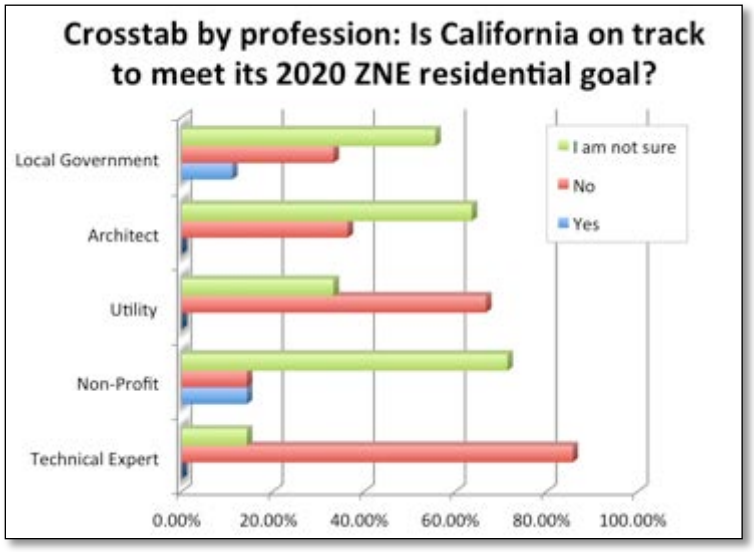
Figure 2. ZNE goals impacts

"This will have an effect on proposed residential projects, however, without regulations, many builders will be reluctant to adopt voluntarily" – Survey respondent

Is California on track to meet its ZNE residential goals? (q. 8)

45.3% of respondents indicated that California is not on track to meet its residential ZNE goals, and only 5.3% believe that the State is on track. Most people were unsure. Looking at the top respondents by profession, there is a definite difference in how each group responded with technical experts and utilities being the least optimistic. (see Chart 1)

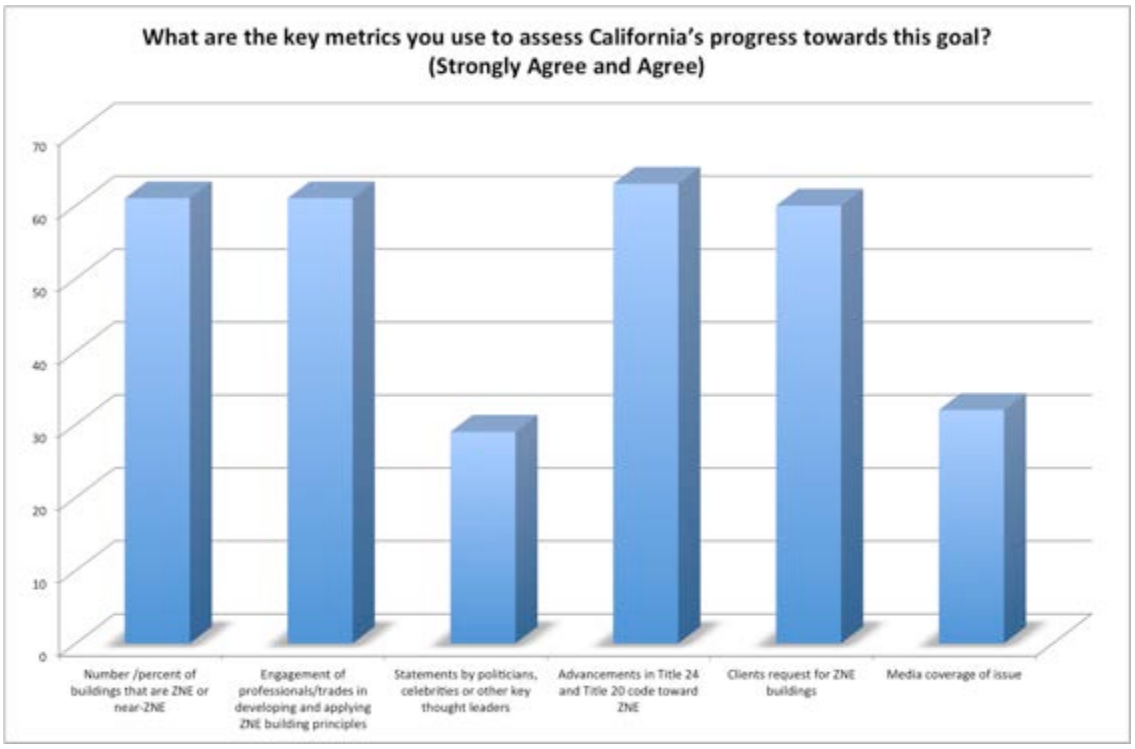
Chart 1. Is California on track?



What metrics do you use to assess California's progress toward this goal? (q. 9)

Four of the six choices for key metrics were most often chosen by respondents as illustrated by the chart below: number or percentage of ZNE buildings; Engagement of professionals; advancement in ZNE codes; and client's demand. In the written responses other metrics identified included: actual reduction of energy use on utility bills; consumer behavior change; and utility support.

Chart 2. Key Metrics



What are the most critical needs to achieve the 2020 goal? (q. 10)

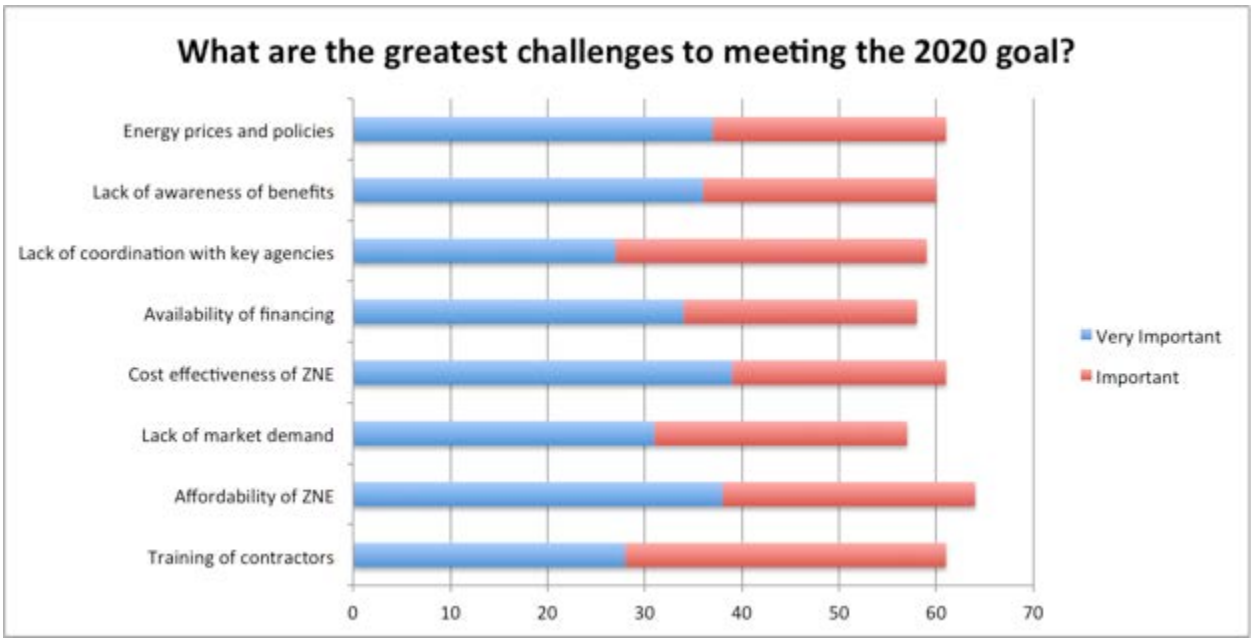
Respondents indicated that nearly all of the listed needs are critical to meeting the 2020 goal. The most critical ones are: codes and regulations; technical training for builders; demonstration projects and outreach and support for builders. Collaboration tools and the development of new technologies were identified as the least important of the group. Some of the written comments include the need to drive demand; educate building inspectors and code enforcement people; better access to data; conduct broader outreach to real estate agents and appraisers; consumer awareness; and strong policies.

"Information transparency - dissemination of aggregated utility data for comparisons & benchmarking." – Survey respondent

What are the greatest challenges to meeting the 2020 goal? (q11)

While all of the identified challenges were indicated as important, cost concerns of ZNE are identified as the primary challenge for meeting the goal. Cost is a consideration in the top three "very important" responses: affordability of ZNE; Cost effectiveness of ZNE; and energy prices and policies. The fourth most important challenge is the lack of awareness and understanding of benefits of ZNE.

Chart 3. Greatest Challenges



"We need to emphasize incentives for cost effective energy efficiency retrofits for existing housing to get maximum impact. Energy Upgrade, Green Point Rating/Label incentives and the various solar PV and hot water programs are all critical and need to be funded and maintained over long term." – Survey respondent

Research Needs (q. 12/13)

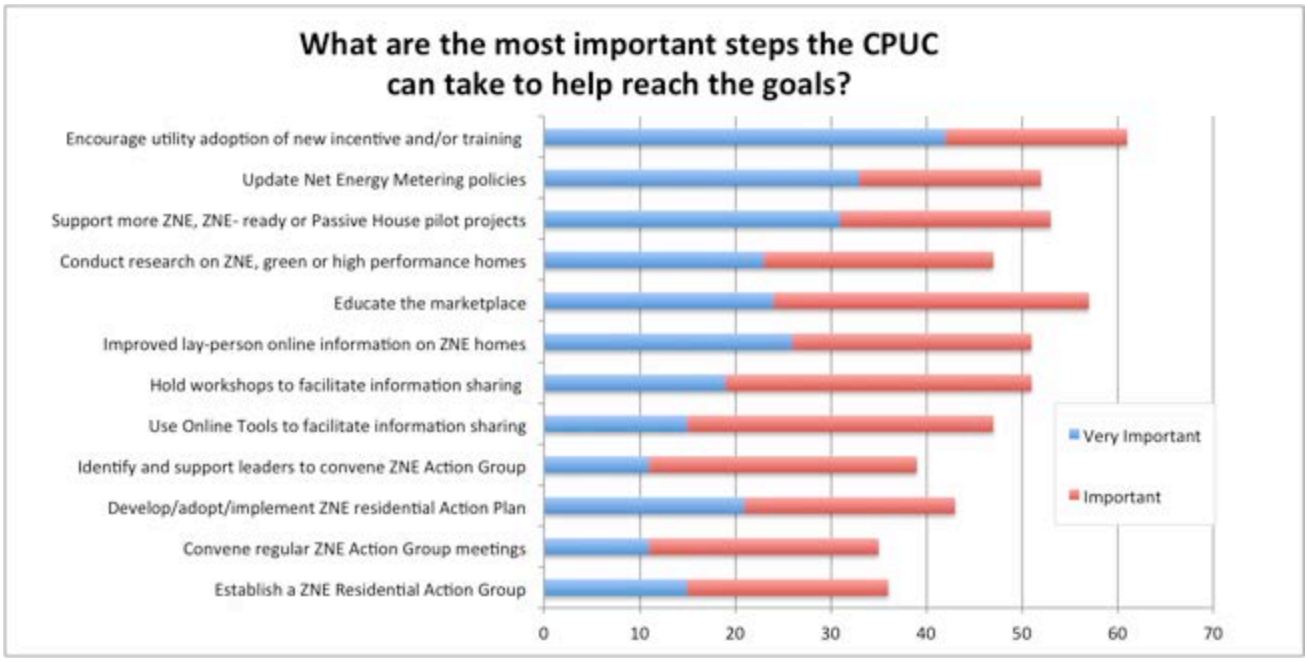
51% of respondents felt that there are unmet research needs, particularly in the area of consumer behavior in ZNE buildings and best practices. Other written responses highlight the need to research high-rise multifamily, plug loads, tracking and reporting, and utility business models to support ZNE.

What are the most important steps for the CPUC? (q. 14)

In terms of critical steps and role for CPUC, respondents indicated four main areas to concentrate efforts: Encourage utility adoption of new incentives and training; update net metering policies; support the development of more pilot projects; and to educate the marketplace about ZNE. Close behind those top priorities include; holding workshops and improving lay-person information about ZNE. (See Chart 4 below) Written comments highlight the need for a strong policy, cost effectiveness, and codes. One comment questions what the actual authority of the proposed ZNE Action Group will be to inform and impact the future of ZNE.

"Honestly, the CPUC is limited in its authority. This should be coming from the Governor or the legislature. The CPUC just oversees the EE programs, which are not going to get us where we need to be." – Survey respondent

Chart 4. Important Steps for CPUC



What priorities should the proposed ZNE Homes 2020 Vision Framework focus on? (q. 15)

In terms of priorities for the Vision Framework, the two most important areas are training and education, and utility programs and incentives. Nearly as important, are working with residential developers and addressing codes and regulations. As in other areas, technical innovations are the lowest priority. Marketing and outreach is rated lower than most of the other areas, which is in conflict to comments in other sections that indicate a need for consumer education and awareness. It may be that respondents feel that this effort can best support the goals by focusing on what is under the CPUC's authority, leaving marketing to the industry and others.

Chart 5. Priorities